

## CLAIMS

I claim:

1. An apparatus for measuring the fatigue life of a structural member of known composition, said apparatus comprising:
  - a. a flat test-coupon uniformly cast and composed of any material mountable on said structural member,
  - b. said test-coupon having at least two cut-out portions of different area which define at least two parallel ligaments of different lengths, and
  - c. said ligaments having a shape so as to effect failure due to fatigue of said ligaments at lower percentages of fatigue life of said structural member and prior to failure of said structural member due to fatigue when said ligament and said structural member are subjected to substantially similar stress conditions and history.
2. The apparatus according to Claim 1 wherein said test coupon is composed of a material other than that composing said structural member.
3. The apparatus according to Claim 1 wherein said cut-out portions are rectangular in shape having rounded corners described by ninety degree arcs joining any two adjacent sides such that said ligaments are all of equal length and width.

4. The apparatus according to Claim 3 wherein said test coupon is composed of a material other than that composing said structural member.

5. The apparatus according to Claim 1 wherein said cut-out portions define said ligaments having a shape described by at least two centrally aligned adjoining rectangles of different surface area, said centrally aligned adjoining rectangles having rounded corners described by ninety degree arcs joining any two adjacent sides and positioned so that said centrally aligned adjoining rectangles become progressively smaller in surface area.

6. The apparatus according to Claim 5 wherein said test coupon is composed of a material other than that composing said structural member.

7. The apparatus according to Claim 1 wherein said test-coupon has at least two cut out portions of equal cross-sectional area and which define at least two ligaments of the same length and the same shape with different elastic moduli.

8. The apparatus according to Claim 7 wherein said test coupon is composed of a material other than that composing said structural member.

9. An apparatus for multidirectional measurement of fatigue life of a structural member of known composition, said apparatus comprising:

- a. a flat test-coupon uniformly cast and composed of any material mountable on said structural member,
- b. said test-coupon having at least two groupings of at least two cut-out portions of different area which define at least two parallel ligaments of different lengths,
- c. said ligaments having a shape so as to effect failure due to fatigue of said ligaments at lower percentages of fatigue life of said structural member and prior to failure of said structural member due to fatigue when said ligament and said structural member are subjected to substantially similar stress conditions and history, and
- d. said groupings arranged such that said parallel ligaments in any said grouping will not be parallel to said parallel ligaments in any other said grouping in said test-coupon.

10. The apparatus according to Claim 9 wherein said test coupon is composed of a material other than that composing said structural member.

11. The apparatus according to Claim 9 wherein said cut-out portions are rectangular in shape having rounded corners described by ninety degree arcs joining any two adjacent sides such that said ligaments are all of equal length and width.

12. The apparatus according to Claim 11 wherein said test coupon is composed of a material other than that composing said structural member.
13. The apparatus according to Claim 9 said cut-out portions define said ligaments to have a shape described by at least two adjoining rectangles of different surface area:
  - a. positioned so that each successively smaller rectangular portion of said ligament is centered on the next larger adjoining rectangular portion of said ligament, and
  - b. having rounded corners described by ninety degree arcs joining any two adjacent sides.
14. The apparatus according to Claim 13 wherein said test coupon is composed of a material other than that composing said structural member.
15. The apparatus according to Claim 9 wherein said test-coupon has at least two cut out portions of equal cross-sectional area and which define at least two ligaments of the same length and the same shape with different elastic moduli.
16. The apparatus according to Claim 15 wherein said test coupon is composed of a material other than that composing said structural member.

17. A method for measuring fatigue strength and fatigue damage of a structural member of known composition comprising the steps of:

- a. providing a test-coupon having known fatigue characteristics and configured so as to experience material failure due to fatigue prior to said structural member,
- b. subjecting said test-coupon to repetitive stress loading so that said test-coupon and said structural member have a substantially similar stress history,
- c. rigidly attaching said test-coupon upon said structural member so that said test-coupon experiences the same stress loading as said structural member,
- d. subjecting said test-coupon and said structural member to repetitive stress loading of a constant displacement,
- e. monitoring said test-coupon to determine how many loading cycles are necessary to cause failure in each of said ligaments, and
- f. using number of loading cycles necessary to cause failure in each of said ligaments for fatigue strength of each of said ligaments and to predict remaining useful service life of said structural member on the basis of an S-N curve depicting stress loading characteristics of material from which said structural member is composed.

18. The method according to Claim 17 wherein said test coupon is composed of a material other than that composing said structural member.

19. A method for measuring fatigue strength of a structural material comprising the steps of:

- a. making a flat test-coupon uniformly cast of material identical to that comprising said structural member, said test-coupon having at least two cut-out portions of different area which define at least two parallel ligaments of different lengths,
- b. subjecting said test-coupon to repetitive loading of a constant displacement until all of said ligaments in said test-coupon fail,
- c. monitoring said test-coupon to determine how many loading cycles are necessary to cause failure in each of said ligaments, and
- d. using number of loading cycles necessary to cause failure in each of said ligaments to compute fatigue strength of each of said ligaments at a given displacement.